LAKE COUNTY, ILLINOIS

2011 FOURTH LAKE

PREPARED BY THE

LAKE COUNTY HEALTH DEPARTMENT

Population Health Environmental Services

Figure 1. Water quality sampling points in Fourth Lake, 2011.

SPECIAL POINTS OF INTEREST:

- *Chlorides*
- *Total Phosphorus*
- *Aquatic Plants*

INSIDE THIS ISSUE:

Fourth Lake is an approximately 305.6 acre glacial lake located in unincorporated Lake County near the municipalities of Lindenhurst and Grayslake. Fourth and Miltmore were historically one lake, however, a berm now separates the two providing access to homeowners. The lake is used for fishing, hunting, swimming and aesthetics. Motorboats are not allowed.

In 2011, Fourth Lake was monitored for water quality at two sites by the LCHDES (Figure 1). One site was located in the middle of the lake (deep hole) and the other was an inlet coming from a more recently constructed subdivision that was suspect of introducing sediments into Fourth Lake via effluent from a detention basin during the 2000 monitoring year. A multiparameter sonde was used to collect temperature, pH, dissolved oxygen, and conductivity at each sampling point. Additionally water samples were collected using a Van Dorn sampler and tested for alkalinity, phosphorus, nitrogen, solids, and chloride. Assessments were made of aquatic vegetation, shoreline erosion, land use and watershed.

The overall water quality of Fourth Lake is very good, however, the total phosphorus (TP) concentration measured at the deep hole during May, 2011 was 0.052 mg/L, this is in violation of the Illinois Environmental Protection Agency's (IEPA) phosphorus standard of ≥ 0.05 mg/L. The total phosphorus (TP) concentrations in Fourth Lake ranged

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SUMMARY (CONTINUED)

Lake Facts:

Major Watershed: Des Plaines

Sub-Watershed: Mill Creek

Location: T41N, R10E, Sections 10, 11 and 12

Surface Area: 305.6 acres

Shoreline Length: 6.0 miles

Maximum Depth: 5.5 feet

Average Depth: 2.75 feet

Lake Volume: 840.68 acre-feet

Watershed Area: 3,114.40 acres

Lake Type: Glacial

Management Entities: Multiple

Current Uses: fishing, hunting, swimming and aesthetics. No motorized boating allowed.

Access: Public

from 0.023 mg/L to 0.036 mg/L at the inlet and 0.030 mg/L to 0.052 mg/L at the deep hole. The 2011 average TP concentration was 0.028 mg/L at the inlet and 0.037 at the deep hole, these are both below the median TP concentration of 0.066 mg/L for lakes in the county monitored for phosphorus between 2000 and 2011. However, it has increased at both points since 2000 when average TP concentrations were 0.018 mg/L and 0.033 mg/L at the inlet and deep hole, respectively.

Phosphorus and nitrogen are normally limiting nutrients in our region. The ratio of total nitrogen to total phosphorus (TN:TP) in 2011 was 35:1 the inlet and 28:1 deep hole. These ratios indicate that plant and algal growth in Fourth Lake was limited by phosphorus availability. Therefore it is important to reduce inputs of phosphorus coming into Fourth Lake from the watershed.

Total Kjeldahl Nitrogen, (TKN) at the inlet ranged from 0.86 mg/L in May to 1.17 mg/L in July. TKN concentrations at the deep hole ranged from 0.92 mg/L in June to 1.45 mg/L in July. The average TKN concentrations were 1.00 mg/L and 1.05 mg/L at the inlet and the deep hole, respectively. These concentrations were below the median TKN concentration from 842 samples taken from lakes in the county between 2000 and 2011 of 1.18 mg/L. TKN is the organic form of nitrogen and is usually tied up in plant and algal cells and therefore is biologically unavailable. The biologically available nitrogen (nitrate, nitrite and ammonium) in the water was non-detectable for the entire monitoring season, May - September. Any available nitrogen was utilized by aquatic organisms once phosphorus became available.

Carlson's Trophic State Index (TSIp) uses average TP to estimate the trophic state of a lake. The TSIp for Fourth Lake was 52 at the inlet and 56 at the deep hole; based upon theses TSIp values Fourth Lake is an eutrophic or nutrient rich lake. It ranked 31st out of 171 lakes in the county measured for phosphorus between 2000 and 2011.

There are many potential sources of phosphorus available in Fourth Lake. Internal cycling of phosphorus occurs when DO concentrations become low, ≤2.0 mg/L near the lake bottom, this occurred in Fourth Lake during July, as the DO concentration was measured at 2.19 mg/L at the deep hole. Carp are also source of phosphorus in Fourth Lake, their feeding and mating habits re-distribute phosphorus laden bottom sediments into the water column. Activities taking place in the watershed such as turf fertilization and usage of the Fourth Lake by waterfowl can additionally increase TP concentrations. Reminding residents to use phosphorus-free fertilizers and to take actions to minimize goose populations around water features in the watershed are among recommended practices used to reduce phosphorus.

The average chloride concentrations in Fourth Lake were 205 mg/L and 202 mg/L at the inlet and deep hole, respectively. These concentrations remain below the critical concentration of 230 mg/L, defined by the U.S. Environmental Protection Agency (USEPA) for general use, however, they have increased 111% and 110% from 2000 when the chloride concentrations were 97 mg/L and 96 mg/L respectively for the inlet and deep hole; and they are above the median chloride concentration from 552 samples taken from county lakes since 2000 of 145 mg/L. The main contributing factor of increased chlorides has been linked to deicing products such as rock salt used for winter road maintenance; however, water softener system discharges have also been identified as another source of chlorides and may also contribute to elevated chloride concentrations in Fourth Lake. It only takes one teaspoon of salt placed into 5 gallons of water to reach the critical concentration of 230 mg/L. It is important to try to reduce chlorides in water as entire ecosystems are impacted if concentrations remain at the critical level for extended periods of time.

SUMMARY (CONTINUED)

The aquatic vegetation in Fourth Lake was assessed in July, 2011. Two hundred twenty-eight points that fell within the lake footprint were assessed and 97% percent of the points sampled were colonized by aquatic vegetation. The estimated plant density in the lake was 75.5%. Nineteen species of plants were found in the lake during the survey. Curlyleaf Pondweed and Eurasian Water Milfoil were detected in the survey, both of these plants are non-native, aquatic invasive species. Eurasian Water Milfoil was co-dominant in the lake along with White Water Lily and Common Bladderwort. The Floristic Quality Index (FQI) score was 24.7, ranking it 10th out of 158 lakes in the county whose FQI was calculated between 2000 and 2011.

WATER CLARITY

Water clarity is measured by Secchi disk. At each visit, the disk is lowered into the water column at the deepest part of the lake until the disk is no longer visible.

Fourth Lake has excellent water clarity, although this is not reflected in the average Secchi depths of 2.76 feet and 2.25 feet measured at the inlet and deep hole, respectively. This is due to the Secchi disk being obstructed by plants in May at both locations and at the inlet during August. In June, the water clarity at the inlet was such that the Secchi depth was obstructed by the lake bottom. The average Secchi depths are slightly below the median Secchi depth of for all lakes in the county whose Secchi depths were measured between 2000 and 2011. Fourth Lake ranked 60th out of 157 lakes in the county whose average Secchi depths have been measured since 2000. Due to the depth and the abundance of vegetation in Fourth Lake, it is limited in its ability to rank high for water clarity.

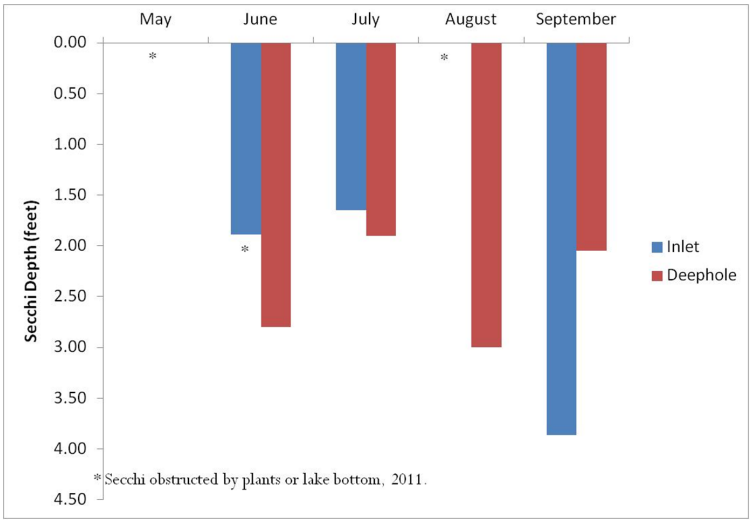


Figure 2. Water clarity at both the inlet and the deep hole of Fourth Lake, 2011.

TOTAL SUSPENDED SOLIDS (TSS)

Total Suspended Solids (TSS) are made up of both volatile solids (TVS), which come from organic sources such as plankton and algae; and sediment which are considered non-volatile solids (NVSS). Both adversely affect water clarity.

The average TSS in Fourth Lake was 4.9 mg/L at the inlet and 6.3 mg/L at the outlet. These are both below the county median of 8.6 mg/L for lakes measured for TSS between 2000 and 2011. TSS concentations at the inlet of Fourth Lake ranged from 1.9 mg/L in June to 8.4 mg/L in September; and 1.8 mg/L in August to 11.5 mg/L in June at the deep hole.

Figures 3a and 3b show the concentrations of TVS and NVSS found at the inlet and deep hole of Fourth Lake in 2011. TVS concentrations ranged from 114 mg/L to 140 mg/L at the inlet and 112 mg/L to 139 mg/L at the deep hole. The average TVS was 127 mg/L at the inlet and 125 mg/L at the deep hole; these concentrations are slightly higher than the median TVS concentration of 122 mg/L for lakes in the county measured for TVS since 2000. The average NVSS concentration at the inlet was 2.89 mg/L and 3.76 mg/L at the deep hole.

Fourth Lake is a very productive lake with both an abundant plant and animal (planktonic) community. During July, it was noted that there was an abundant carp population inhabiting the lake and an algal bloom was present.

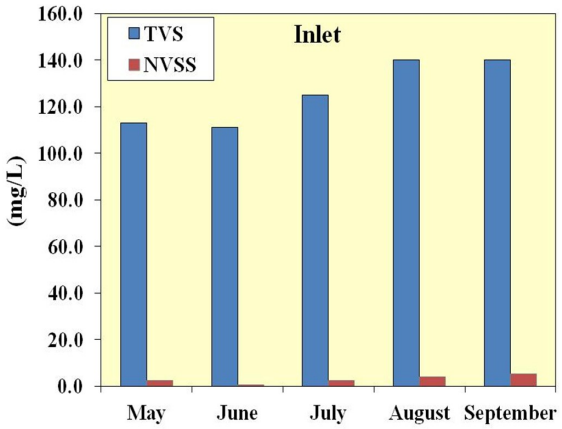


Figure 3a. TVS and NVSS concentrations at Fourth Lake inlet, 2011.

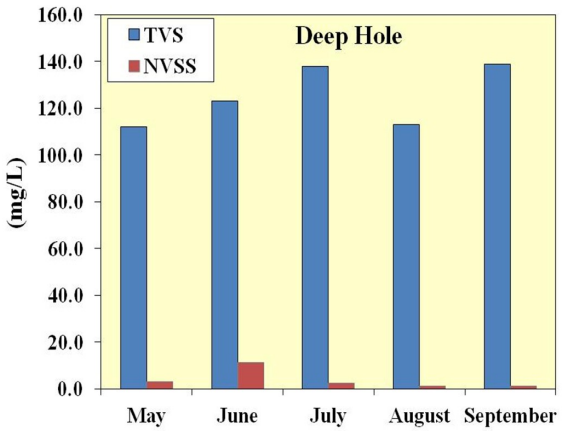


Figure 3b. TVS and NVSS concentrations at Fourth Lake deep hole, 2011.

NUTRIENTS

Phosphorus and nitrogen are normally limiting nutrients in natural systems. Total phosphorus (TP) concentrations found in Fourth Lake were good during most of the season. Concentrations at the inlet ranged from 0.023 mg/L to 0.036 mg/L ; the deep hole had concentrations ranging from 0.30 mg/L to 0.52 mg/L. The 0.52 mg/L concentration at the deep hole was a violation of the IEPA standard of 0.05 mg/L for lakes with a surface area ≥ 20 acres (Figure 4). The average TP concentration at the inlet was 0.028 mg/L; and at the deep hole was 0.037 mg/L. These concentrations were both below the median concentration of 0.066 mg/L from lakes in the county monitored since 2000.

NUTRIENTS

Total nitrogen to total phosphorus ratios (TN:TP) determine which of the two nutrients (phosphorus or nitrogen) limit the growth of plants and algae. Ratios over 20:1 indicate a system limited by phosphorus; under 10:1, the system becomes limited by nitrogen. Ratios falling between 10:1 and 20:1 indicate that the system has plenty of both nutrients to support nuisance plant and algae growth. Fourth Lake was limited by phosphorus; however, the inlet was much more limited by phosphorus with a TN:TP ratio of 35:1 than was the deep hole with a TN:TP ratio of 28.1. Since plant and algal growth are limited by phosphorus, it is important to minimize phosphorus inputs from the watershed. Also, feeding and mating carp can be tremendous source of phosphorus and are likely responsible for the increased phosphorus found at the deep hole, many carp were observed near that location during the June visit.

The average Total Kjeldahl Nitrogen (TKN) was 1.00 mg/L at the inlet and 1.03 mg/L at the deep hole. These concentrations are below the median TKN concentration of 1.18 mg/L for lakes in the county sampled for TKN between 2000 and 2011. TKN is tied up in plant and algal cells; and therefore biologically unavailable. The biologically available forms of nitrogen (nitrate, nitrite and ammonium) were not detectable in Fourth Lake at any time during the monitoring period in 2011.

Fourth Lake is considered an eutrophic lake based upon its Trophic State Index (TSIp) scores at the inlet and deep hole of 52 and 56 respectively. The TSIp is based upon the total average phosphorus concentration. The higher the score the more nutrient enriched the lake is. Fourth Lake ranked 31st out of 174 lakes from the county that were assessed for phosphorus between the years 2000 and 2012.

Phosphorus (P) can be introduced into a system either from external sources (i.e. watershed) or internally from bottom sediments and aquatic organisms such as carp. DO concentrations measured in July approached 2 mg/L near the lake bottom and are conducive to the release of phosphorus by bottom sediments. Carp were noted in Fourth Lake at various times during the season. Their feeding and mating habits distribute phosphorus laden sediments into the water. Finally, the Fourth Lake watershed is expansive with a watershed to surface area ratio of approximately 147:1; therefore, activities taking place in the watershed can have a significant impact on the water quality of Fourth Lake. In order to reduce phosphorus imputs into Fourth Lake, it is recommended by the LCHD-ES that the residents and businessmen and the municipalities implement practices into their landscape management plans to reduce phosphorus inputs into the environment, this includes the use of phosphorus-free fertilizers and minimizing goose populations in water features throughout the watershed. Fishermen should physically remove carp from the lake when they are caught while angling.

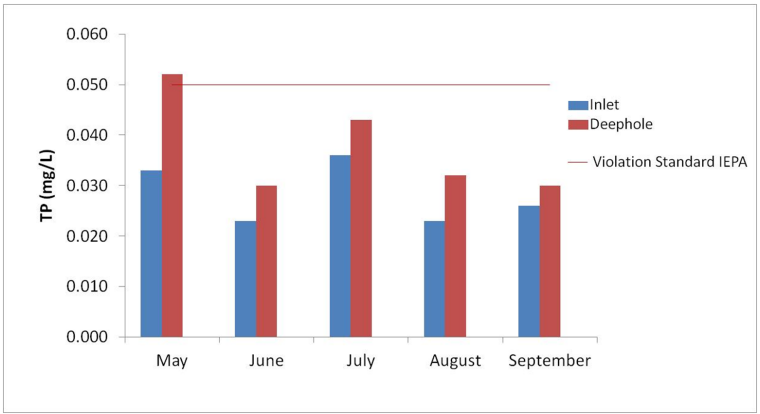


Figure 4. TP Concentrations measured in Fourth Lake at the inlet and deep hole during 2011.

WATERSHED

The Fourth Lake watershed is estimated at 3,114.40 acres and is dominated by Single Family, Water and Public and Private Open Space land use (Figure 5). However, it is important to realize that land uses that contribute the greatest amount of run off are not always those that dominate the watershed. Single Family and Transportation contributed the greatest amount of runoff (Appendix A, Table 5) to Fourth Lake; hence, residents, business owners and municipalities all should be thoughtful when managing their properties. Reminders should be sent out to residents about the importance of using phosphorus-free fertilizers as well as their not behaving in ways that promote goose populations such as the feeding of geese.

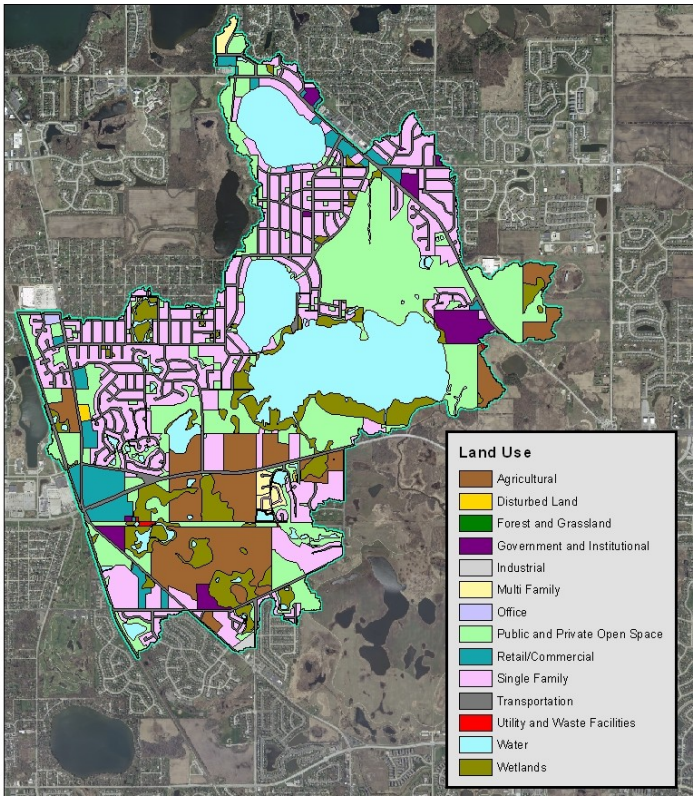


Figure 5. Watershed and land use of Fourth Lake, 2011.

DISSOLVED OXYGEN (DO)

Dissolved oxygen (DO) is essential for the survival of fish and invertebrates and influences many different biological and chemical processes.

Due to the long fetch and shallowness of Fourth Lake, it remained well mixed. DO concentrations measured at the deep hole ranged from 2.19 mg/L in July to 11.49 mg/L in May. The July concentration was low enough to trigger the release of phosphorus from anoxic bottom sediments.

Additionally at the deep hole, the DO concentrations were below 5 mg/L within one foot of the surface is June, July and September, these concentrations are not conducive for supporting a healthy fishery.

DO concentrations at the inlet were good; however, the % DO concentrations did become supersaturated. Supersaturation occurs when % DO concentrations are >100%. If % DO of greater than 110% is maintained in the water for extended periods of time, adverse impacts can begin occur to fish. In rare cases, excessive DO can lead to gas bubble disease, where oxygen bubbles or emboli block the blood flow through blood vessels.

The % DO was considered supersaturated from May through June and again in August. Concentrations in May and August were above 110% throughout the entire water column.

CONDUCTIVITY/CHLORIDE (CONTINUED)

Conductivity measures the amount of ions contained in a waterbody. The more ions or salts that a waterbody contains the higher its conductivity. Conductivity can be used to estimate both total dissolved solids (TDS) and chloride concentrations due to a strong correlation between these parameters. LCHD-ES has decided in more recent years to analyze chloride concentrations due to a strong relationship discovered between road salt usage (which contains 40% chloride) and increasing chloride concentrations in waters throughout the County. Water softeners have been found to play a more important role in increasing chloride concentrations than originally was thought. It does not take much to increase chlorides, only1 teaspoon of salt (chloride) to 5 gallons of water can increase chlorides to the critical chloride concentration of 230 mg/L defined by the United States Environmental Protection Agency (USEPA). Once chlorides are in water they remain there indefinitely, unless it is somehow diluted or treated by a reverse osmosis system, the latter being a very expensive alternative.

In 2011, the average chloride concentration at the inlet of Fourth Lake was 205 mg/L and 202 mg/L at the deep hole, these concentrations are both above the median concentration of 145 mg/L for lakes in the county measured for chloride between 2000 and 2011. Chlorides ranged from 183 mg/L to 233 mg/L at the inlet and 171 mg/L to 228 mg/L at the deep hole (Appendix A, Table 1). Normally, one would expect to see higher chloride concentrations occur earlier in the season due to snowmelt runoff; however, dry conditions likely contributed to the higher chloride concentration in Fourth Lake in July; rains occurring between the July and August sampling dates likely diluted the chlorides in the lake (Figure 6). Adverse impacts can occur if chloride concentrations hit the critical concentration and are maintained for prolonged periods. Shifts in algal populations toward blue-green algae have been documented at concentrations as low as 12 mg/L.

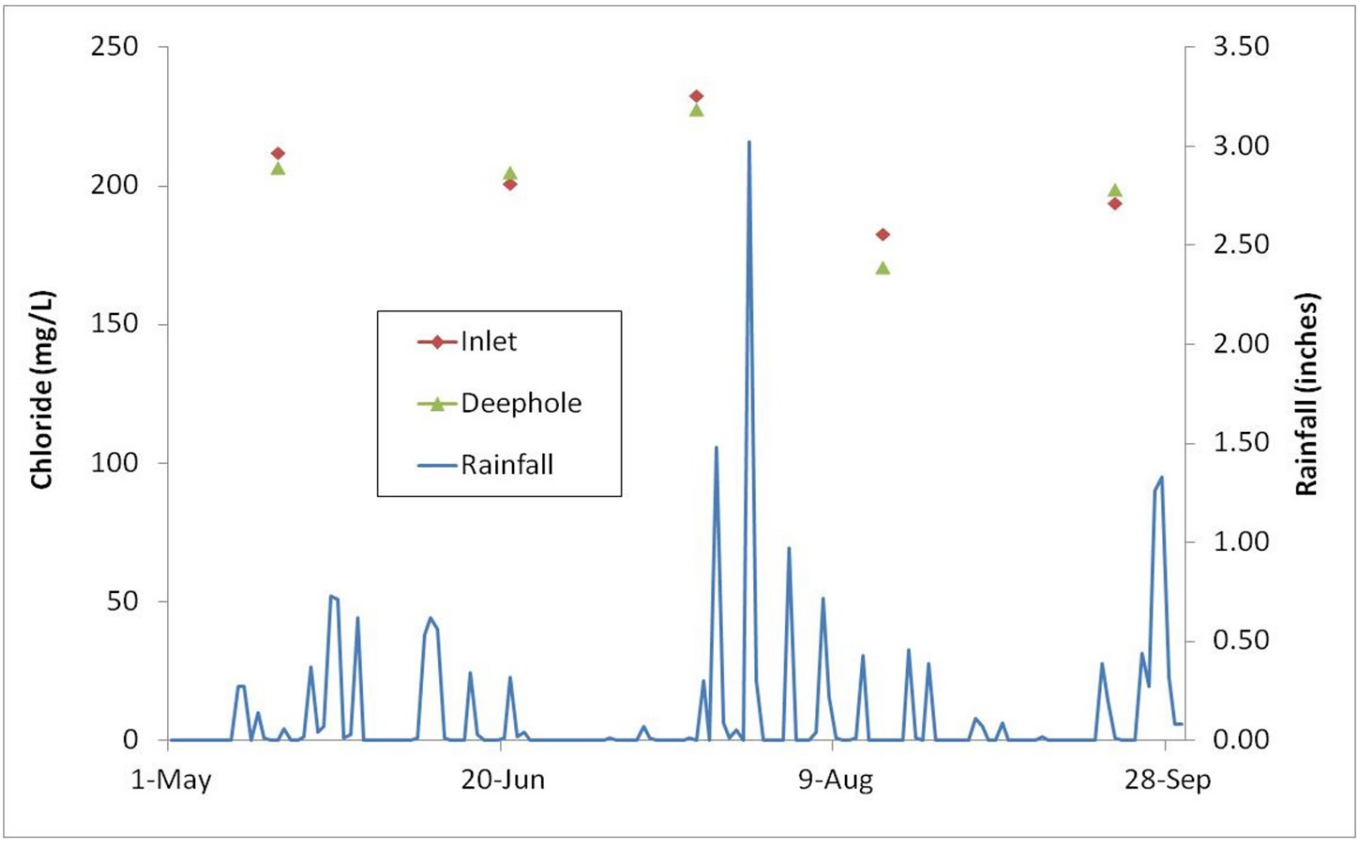


Figure 6. 2011 Fourth Lake chloride from sample dates versus seasonal rainfall. (Rainfall data provided by Lake County Stormwater Commission, Lindenhurst rain gauge data, 2011).

CHLORIDE/CONDUCTIVITY (CONTINUED)

It only takes1 teaspoon of salt to pollute 5 gallons of water.

Single family and transportation were estimated to contribute the greatest amount of runoff from the watershed and therefore residents, businesses and the municipalities should be thoughtful of their salt usage whether it be from winter maintenance or water treatment. The "What can I do to help?" tip box that follows, provides tips on how you can reduce salt use around your home.

The LCHD-ES and Lake County Stormwater Management Commission (LCSMC) have been holding annual training sessions targeting deicing maintenance personnel for both public and private entities. This is an attempt to educate winter road maintenance crews on the recommended application rates for applying deicers and hopefully will reduce the amount of chloride being introduced into our environment while maintaining safe passageways.

Almost all deicing products contain chloride so it is important to read the product label for proper application. For instance, at 10° Fahrenheit, rock salt is not at all effective in melting ice and will blow away before it melts anything. Homeowners should encourage the local snow removal agency to implement practices that reduce the usage of deicing products on their properties and roadways.

What can I do to help?

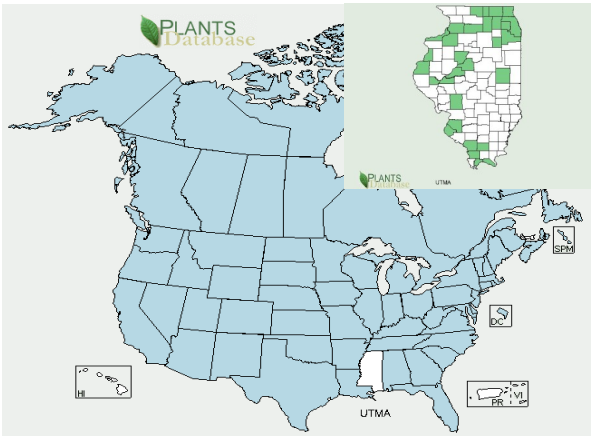
- Shovel (or use a snow blower) before you use any product; never put a deicing product on top of snow.
- Read the product label, before applying product.
- Sweep up un-dissolved product after a storm is over for reuse.
- Consider switching to a non-chloride deicer.
- Support changes in chloride application in your municipality.
- Inform a neighbor about the impacts chlorides have on our lakes rivers and streams.

Modified from (DuPage River Salt Creek Workgroup , 2008)

Aquatic Plants

Common Bladderwort

Common Bladderwort (*Utricularia vulgaris*) is a widespread native. Populations have been documented in Lake County as well as other counties in Illinois. Common bladderwort is a carnivourous plant which means it eats small animals. It does so through hundreds of small bladders scattered throughout its finely divided alternate leaves. It is a free-floating plant that remains submerged floating to the surface before flowering, at which time the flower and stalk protrude from the water. The flower blooms from May through September. The plant can measure up to seven feet across. It is used by animals for both food and shelter. It can be confused with other aquatic plants such as EWM. However, EWM has leaves in whorls of 4 - 5 leaves per whorl and lacks bladders.



Aquatic plants are a critical feature in lakes as they compete against algae for available nutrients, improve water quality and provide fish habitat for nesting and nursery. An aquatic vegetation survey was conducted on Fourth Lake in July, 2011.

A 60-meter grid was randomly overlaid on an aerial photo of Fourth Lake and a total of 229 points fell within the lake footprint were assessed. Due to the expansion cattail fringe, one of the sites was inaccessible and therefore not sampled. Ninety-seven percent of the points sampled were vegetated in both of the assessments. It is estimated that the total average plant density was 75.5% (Figure 7). Eurasian Water Milfoil (EWM), White Water Lily and Common Bladderwort were the top three dominant species in Fourth Lake during 2011. Eurasian Water Milfoil (EWM) is a non native, invasive species as is Curlyleaf Pondweed which was also detected, however, it only had an estimated density of 0.1% and a frequency of 0.9%. No chemical treatments were applied to Fourth Lake in 2011. The LCHD-ES recommends that EWM populations be managed. This would allow the native plant population of Fourth Lake to expand.

In 2011, there were a total of nineteen species detected in Fourth Lake equating to an FQI of 24.7. Floristic quality assessments allow for comparisons among sites. Fourth Lake ranked 10th of 160 lakes assessed in the county for floristic quality between 2000 and 2012.

Rake Density - July

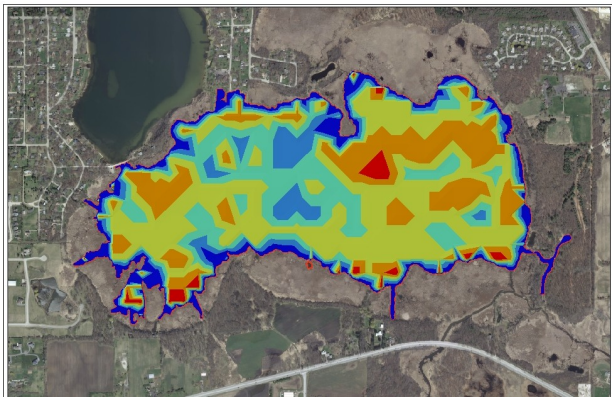


Figure 7. Rake density in Fourth Lake, July 2011.

AQUATIC PLANT MANAGEMENT - PESTICIDES

EWM was the top dominant plant species found on Fourth Lake in 2011with an average density of 18.3% and a frequency of 66.2% (Figure 8). Curlyleaf Pondweed was detected in our survey but only had an average density of 0.1% and a frequency of 0.9%.

FOR FULL DETAILS OF THE PESTICIDE RULE SEE:

HTTP://WWW.EPA.STATE.IL.US/WATER/PERMITS/PESTICIDE/INDEX.HTML

The LCHD-ES recommends that the Lake County Forest Preserve District, Lake Villa Township and private bottom owners along Fourth Lake consider management of populations of EWM. There were many remnant native plant species present in Fourth Lake at the time of this survey whose populations would be allowed to expand in the absence of EWM. If chemicals are used to manage the EWM population in Fourth a notice of intent will need to be filed with the Illinois Environmental Protection Agency. It is important that good chemical treatment records be kept, this includes information such as chemical used, rate, date and location of chemical used.

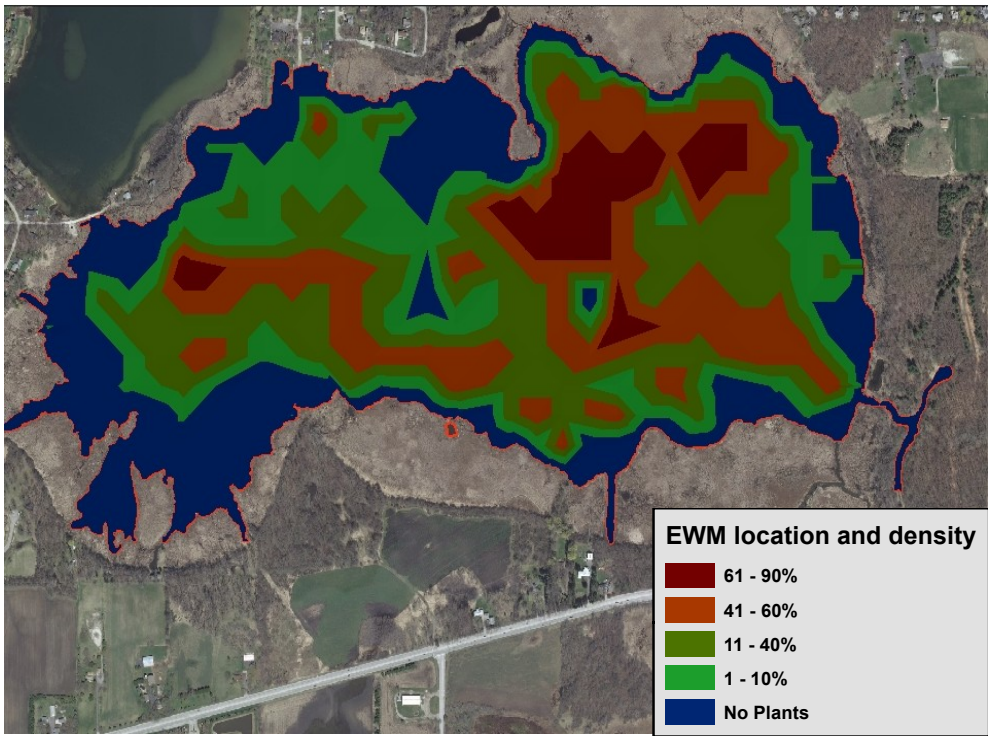


Figure 8. Density and Location of EWM in Fourth Lake, July 2011.

VLMP

Fourth Lake did not have a volunteer lake monitor in 2011 and has not had one in some time. Beginning, 2012, Don Wilson, a citizen of Lake County, has volunteered to collect Secchi data on the lake. He does not live on the lake nor is he a resident of the watershed. VLMP's begin the program taking Secchi disk readings twice a month from May - October. If there are any lake or watershed residents interested in participating in the program they can contact the LCHD-ES at (847) 377-8030.

BATHYMETRIC MAP

Fourth Lake lacks a bathymetric map. The last map constructed for Fourth lake was done by biologist G. Tichacek in 1966 (Figure 9). A bathymetric map and its accompanying morphometric table are useful tools for lake managers as they assists in tasks such as estimating volumes for lake treatment and other decisions involved with the overall plant management plan. They also allows for calculation of anoxic water volumes which helps in managing and maintaining a fishery.

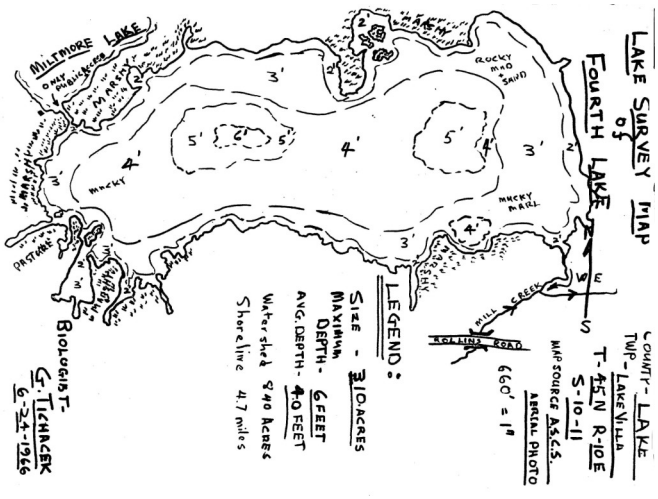


Figure 9. Bathymetric Map, G. Tichacek, 1966.

FISH

In May, 2013 the IDNR biologist surveyed Fourth Lake for fish. The most common fish at that time was Bluegill. There were 11 species in total caught during the 60 minute electro-fish sample. A fish kill affecting multiple species occurred in March of 2011 due to low DO concentrations. The IDNR biologist suggested that given the species remaining in the lake and lack of future kills like the one in 2011, that the sport fishery could recover and re-establish itself in a more balanced form.

Table 1. List of fish species caught during a 60 minute electrofish sample conducted by the IDNR, May 2013.

Species	Number	Min. Length (in.)	Avg. Length (in.)	Max. Length (in.)
Largemouth bass	2	5	7.3	9.5
Bluegill	35	1.7	6.1	7.7
Black crappie	8	5.5	8.3	9.3
Yellow perch	5	4.8	7.2	9
Grass pickerel	4	6.7	8.7	11.8
Pumpkinseed sunfish	5	5.2	5.5	6.0
Golden shiner	6	3.9	4.7	5.5
Common carp	5	8.2	18.6	22.6
Yellow bullhead	1	8.0	8.0	8.0
Bowfin	3	20.7	22.1	24.4
Northern pike	1	30.0	30.0	30.0

LakeCounty
Health Department and
Community Health Center

ENVIRONMENTAL SERVICES

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For more information visit us at:

http://www.lakecountyil.gov/Health/want/BeachLakeInfo.htm

Protecting the quality of our lakes is an increasing concern of Lake County residents. Each lake is a valuable resource that must be properly managed if it is to be enjoyed by future generations. To assist with this endeavor, Population Health Environmental Services provides technical expertise essential to the management and protection of Lake County surface waters.

Environmental Service's goal is to monitor the quality of the county's surface water in order to:

- Maintain or improve water quality and alleviate nuisance conditions
- Promote healthy and safe lake conditions
- Protect and improve ecological diversity

Services provided are either of a technical or educational nature and are provided by a professional staff of scientists to government agencies (county, township and municipal), lake property owners' associations and private individuals on all bodies of water within Lake County.

RECOMMENDATIONS

LCHD-ES recommends the following actions for improving the water quality and overall health of Fourth Lake:

- Due to the expansive watershed to lake volume ratio it is important that residents and business owners in the watershed implement practices to reduce phosphorus and chlorides into the environment. Activities such as using phosphorus free fertilizers, thoughtfully applying deicers to properties and making sure that there are not water softener discharges entering water features which eventually flow into Fourth Lake are all recommended practices.
- Control of Eurasian Water Milfoil in Fourth Lake will open up the canopy for expansion of native vegetation in Fourth Lake.

STOP AQUATIC HITCHHIKERS!™

Prevent the transport of nuisance species.
Clean all recreational equipment.
www.ProtectYourWaters.net

When you leave a body of water:

- Remove any visible mud, plants, fish or animals before transporting equipment.
- Eliminate water from equipment before transporting.
- Clean and dry anything that comes into contact with water (boats, trailers, equipment, clothing, dogs, etc.).
- Never release plants, fish or animals into a body of water unless they came out of that body of water.

APPENDIX A

FIGURES AND TABLES
FOURTH LAKE
2011

Figure 1. Water quality sampling points on Fourth Lake, 2011.

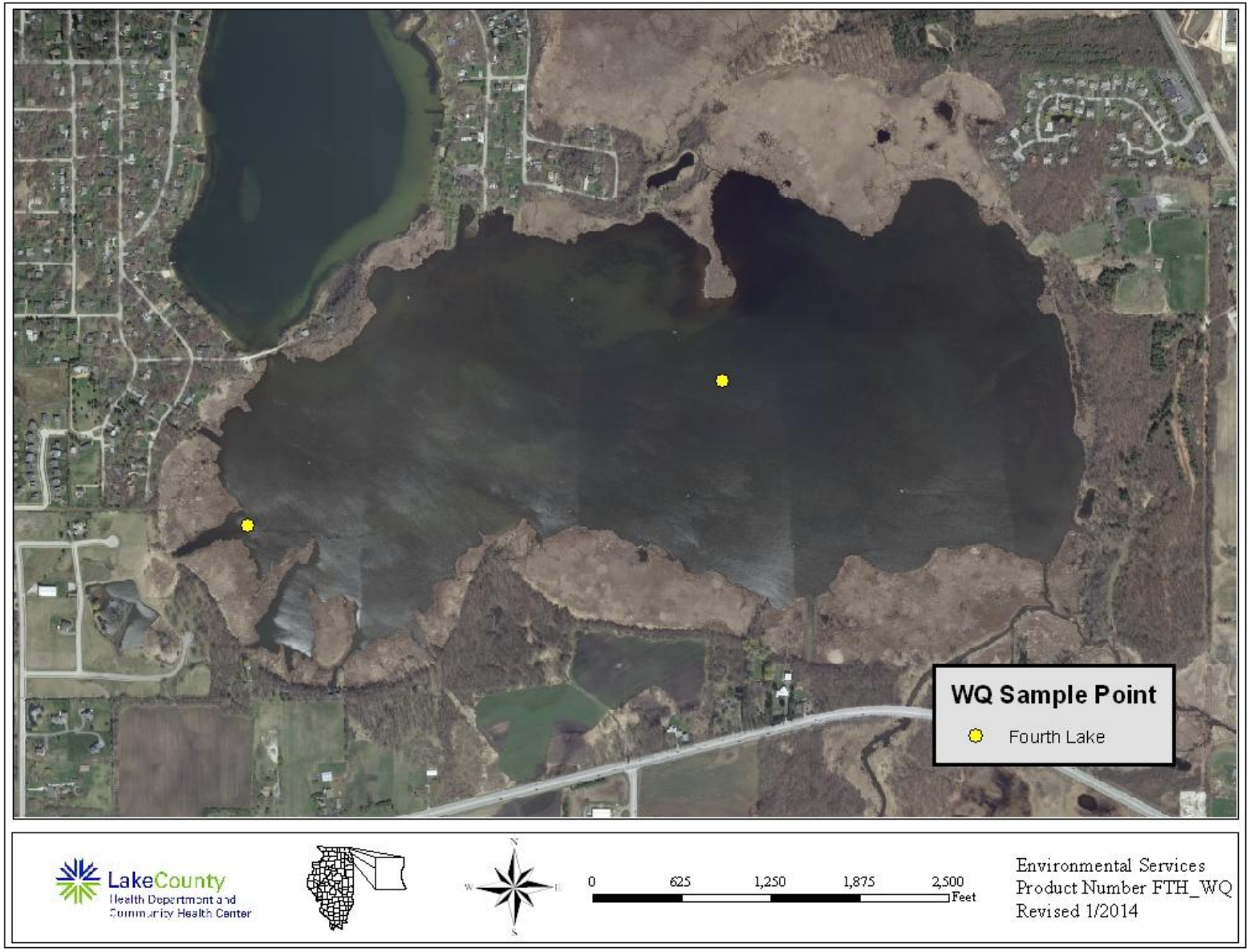

Table 1. Water quality summary for Fourth Lake, 2011 and 2000.

2011	Inlet															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS*	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
17-May	0	179	0.86	<0.1	<0.05	0.033	<0.005	577	212	5.2	637	127	0**	1.0540	8.33	12.61
21-Jun	0	154	0.87	<0.1	<0.05	0.023	<0.005	550	201	1.9	585	119	1.89	0.9990	7.42	4.86
19-Jul	0	244	1.17	<0.1	<0.05	0.036	<0.005	643	233	3.1	751	140	1.65	1.1840	8.02	7.48
16-Aug	0	179	1.06	<0.1	<0.05	0.023	<0.005	508	183	5.9	584	114	0**	0.9150	8.37	11.39
20-Sep	0	177	1.02	<0.1	<0.05	0.026	<0.005	531	194	8.4	614	136	3.86	0.9610	8.51	12.39
	Average	187	1.00	<0.1[k]	<0.05[k]	0.028	<0.005[k]	562	205	4.9	634	127	2.47	1.0226	8.13	9.75

2011	Deep Hole															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_2+NO_3-N	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
17-May	0	181	0.95	<0.1	<0.05	0.052	<0.005	578	207	7.5	624	112	0**	1.0550	8.19	11.51
21-Jun	0	185	0.92	<0.1	<0.05	0.030	<0.005	514	205	11.5	633	123	2.80	0.9280	8.58	9.12
19-Jul	0	199	1.45	<0.1	<0.05	0.043	<0.005	660	228	8.6	698	138	1.90	1.2190	7.12	7.94
16-Aug	0	194	0.95	<0.1	<0.05	0.032	<0.005	517	171	1.8	581	113	3.00	0.9330	7.84	8.99
20-Sep	0	221	0.99	<0.1	<0.05	0.030	<0.005	570	199	2.0	655	139	2.05	1.0390	8.02	5.77
	Average	196	1.05	<0.1[k]	<0.05[k]	0.037	<0.005[k]	568	202	6.3	638	125	2.44	1.0348	7.95	8.67

2000	Inlet															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
23-May	1	141	0.97	<0.1	0.441	0.041	<0.005	402	ND	7.4	441.0	113	1.74	ND	ND	10.52
27-Jun	1	150	0.98	<0.1	0.055	0.026	<0.005	410	87	2.7	404.0	111	0**	0.6506	2.73	10.08
25-Jul	1	187	0.85	<0.1	0.058	0.047	<0.005	382	80	13.0	398.0	125	0**	0.627	2.52	9.93
29-Aug	1	161	1.20	<0.1	0.063	0.026	<0.005	443	112	3.4	463.0	140	0**	0.7293	1.22	8.31
26-Sep	1	188	1.02	<0.1	<0.05	0.023	<0.005	438	105	1.9	449.0	140	0**	0.7066	8.9	9.38
	Average	165	1.00	<0.1[k]	0.15k	0.033	<0.005[k]	415	96	5.7	431	126	1.74	0.5427	3.84	9.64

2000	Deep Hole															
DATE	DEPTH	ALK	TKN	NH_3-N	NO_3-N*	TP	SRP	TDS	Cl^-	TSS	TS	TVS	SECCHI	COND	pH	DO
23-May	3	115	1.09	<0.1	0.053	0.024	<0.005	446	115	2.8	498.0	155	5.18	0.7391	9.28	11.15
27-Jun	2	110	0.93	<0.1	0.055	0.020	<0.005	428	85	1.3	425.0	160	0**	0.6439	9.16	6.41
25-Jul	2	115	0.75	<0.1	0.051	0.016	<0.005	380	75	3.0	404.0	140	0**	0.611	8.94	5.43
29-Aug	2	146	1.1	<0.1	0.052	0.016	<0.005	434	105	1.2	461.0	160	0**	0.7081	8.01	4.39
26-Sep	2	155	0.97	<0.1	<0.05	0.015	<0.005	396	103	0.6	427.0	129	4.33	0.7005	8	8.3
	Average	128	0.97	<0.1[k]	0.054[k]	0.018	<0.005[k]	417	97	1.8	443	149	4.76	0.6805	8.68	7.14

Table 1. Water quality summary for Fourth Lake, 2011 and 2000.

Glossary

ALK = Alkalinity, mg/L $CaCO_3$

TKN = Total Kjeldahl nitrogen, mg/L

NH_3-N = Ammonia nitrogen, mg/L

NO_2+NO_3-N = Nitrate + Nitrite nitrogen, mg/L

NO_3-N = Nitrate nitrogen, mg/L

TP = Total phosphorus, mg/L

SRP = Soluble reactive phosphorus, mg/L

Cl^- = Chloride, mg/L

TDS = Total dissolved solids, mg/L

TSS = Total suspended solids, mg/L

TS = Total solids, mg/L

TVS = Total volatile solids, mg/L

SECCHI = Secchi disk depth, ft.

COND = Conductivity, milliSiemens/cm

DO = Dissolved oxygen, mg/L

k = Denotes that the actual value is known to be less than the value presented.

ND= Data not collected.

* = Prior to 2006 only Nitrate - nitrogen was analyzed.

** = Secchi disk obstructed by either plants or bottom.

Table 2. 2000 – 2011 water quality parameters, statistics summary

	ALKoxic <=3ft00-2011	
Average	**165**	
Median	**160**	
Minimum	**65**	**IMC**
Maximum	**330**	**Flint Lake**
STD	**42**	
n =	**842**	

	ALKanoxic 2000-2011	
Average	**199**	
Median	**190**	
Minimum	**103**	**Heron Pond**
Maximum	**470**	**Lake Marie**
STD	**52**	
n =	**241**	

	Condoxic <=3ft00-2011	
Average	**0.8642**	
Median	**0.7821**	
Minimum	**0.2260**	**Schreiber Lake**
Maximum	**6.8920**	**IMC**
STD	**0.5273**	
n =	**841**	

	Condanoxic 2000-2011	
Average	**0.9953**	
Median	**0.8320**	
Minimum	**0.3210**	**Lake Kathyrn, Schreiber Lake**
Maximum	**7.4080**	**IMC**
STD	**0.7929**	
n =	**241**	

	NO3-N, Nitrate+Nitrite,oxic <=3ft00-2011	
Average	**0.516**	
Median	**0.198**	
Minimum	**<0.05**	***ND**
Maximum	**9.670**	**South Churchill Lake**
STD	**1.059**	
n =	**841**	

*ND = Many lakes had non-detects (75.0%)
Only compare lakes with detectable concentrations to the statistics above
Beginning in 2006, Nitrate+Nitrite was measured.

	NH3-Nanoxic 2000-2011	
Average	**2.135**	
Median	**1.360**	
Minimum	**<0.1**	***ND**
Maximum	**18.400**	**Taylor Lake**
STD	**2.405**	
n =	**241**	

*ND = 22.0% Non-detects from 34 different lakes

	pHoxic <=3ft00-2011	
Average	**8.35**	
Median	**8.35**	
Minimum	**7.07**	**Bittersweet #13**
Maximum	**10.40**	**Summerhill Estates**
STD	**0.46**	
n =	**840**	

	pHanoxic 2000-2011	
Average	**7.31**	
Median	**7.27**	
Minimum	**6.24**	**Banana Pond**
Maximum	**9.16**	**White Lake**
STD	**0.42**	
n =	**241**	

	All Secchi 2000-2011	
Average	**4.39**	
Median	**2.95**	
Minimum	**0.25**	**McDonald 2/Ozaukee/Rollins 2**
Maximum	**20.34**	**Lake Carina**
STD	**3.43**	
n =	**767**	

LakeCounty
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Table 2. 2000 – 2011 water quality parameters, statistics summary

	TKNoxic <=3ft00-2011	
Average	**1.511**	
Median	**1.180**	
Minimum	**<0.1**	***ND**
Maximum	**41.200**	**Almond Marsh**
STD	**1.740**	
n =	**842**	

*ND = 3.6% Non-detects from 14 different lakes

	TKNanoxic 2000-2011	
Average	**2.823**	
Median	**2.120**	
Minimum	**<0.5**	***ND**
Maximum	**21.000**	**Taylor Lake**
STD	**2.345**	
n =	**241**	

*ND = 2.9% Non-detects from 4 different lakes

	TPoxic <=3ft00-2011	
Average	**0.114**	
Median	**0.066**	
Minimum	**<0.01**	***ND**
Maximum	**7.270**	**Almond Marsh**
STD	**0.307**	
n =	**842**	

*ND = 2.1% Non-detects from 7 different lakes

	TPanoxic 2000-2011	
Average	**0.313**	
Median	**0.181**	
Minimum	**0.012**	**Independence Grove**
Maximum	**3.800**	**Taylor Lake**
STD	**0.404**	
n =	**241**	

	TSSall <=3ft00-2011	
Average	**16.6**	
Median	**8.6**	
Minimum	**<0.1**	***ND**
Maximum	**220.0**	**Rollins 2**
STD	**23.4**	
n =	**848**	

*ND = 0.9% Non-detects from 8 different lakes

	TVSoxic <=3ft00-2011	
Average	**127.2**	
Median	**122.0**	
Minimum	**34.0**	**Pulaski Pond**
Maximum	**1090.0**	**Almond Marsh**
STD	**53.0**	
n =	**797**	

No 2002 IEPA Chain Lakes

	TDSoxic <=3ft00-2004	
Average	**470**	
Median	**454**	
Minimum	**150**	**Lake Kathryn, White**
Maximum	**1340**	**IMC**
STD	**169**	
n =	**745**	

No 2002 IEPA Chain Lakes.

	CLanoxic <=3ft00-2010	
Average	**193**	
Median	**128**	
Minimum	**3.5**	**Schreiber Lake**
Maximum	**2390**	**IMC**
STD	**313**	
n =	**174**	

Table 2. 2000 – 2011 water quality parameters, statistics summary

	CLoxic <=3ft00-2011	
Average	**183**	
Median	**145**	
Minimum	**2.7**	**Schreiber Lake**
Maximum	**2760**	**IMC**
STD	**212**	
n =	**638**	

Anoxic conditions are defined <=1 mg/l D.O.
pH Units are equal to the -Log of [H] ion activity
Conductivity units are in MilliSiemens/cm
Secchi Disk depth units are in feet
All others are in mg/L

Minimums and maximums are based on data from all lakes from 2000-2011 (n=1398).

Average, median and STD are based on data from the most recent water quality sampling year for each lake.

LCHD Environmental Services ~ 12/12/2011

Table 3. Fourth Lake multiparameter data, 2011.

Fourth Lake inlet Multiparameter

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
05/17/11	0.25	0.51	12.55	12.61	118.9	1.059	8.28	3699.5
05/17/11	1	1.03	12.49	12.72	119.7	1.054	8.33	3708.8
05/17/11	2	2.00	12.34	12.68	119.0	1.061	8.37	1553.9
05/17/11	3	3.01	11.57	12.49	115.2	1.057	8.37	498.8
05/17/11	4	4.04	11.72	11.21	103.7	1.056	8.29	35.5

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
06/21/11	0.25	0.63	24.39	9.12	109.4	0.930	8.56	1771.3
06/21/11	1	1.09	24.38	8.69	104.2	0.929	8.58	855.7
06/21/11	2	1.99	24.28	8.65	103.5	0.931	8.57	230.9
06/21/11	3	2.74	23.93	8.67	103.2	0.946	8.41	167.3

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
07/19/11	0.25	0.51	30.07	7.48	99.3	1.181	7.99	4154.1
07/19/11	1	1.01	30.18	7.16	95.3	1.184	8.02	3660.2
07/19/11	2	2.05	28.91	6.20	80.8	1.199	7.84	989.2
07/19/11	3	2.55	28.86	3.69	48.0	1.185	7.62	0.2

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
08/16/11	0.25	0.52	24.04	11.39	135.7	0.915	8.37	3426.9
08/16/11	1	1.11	23.86	11.07	131.5	0.911	8.26	3218.8
08/16/11	2	2.01	23.67	11.07	131.1	0.903	8.29	830.8
08/16/11	3	3.07	23.57	11.18	132.1	0.931	8.24	290.6
08/16/11	4	3.80	23.62	10.10	119.4	0.905	8.23	2.3

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
09/20/11	0.25	0.51	16.97	12.39	128.5	0.961	8.51	2979.8
09/20/11	1	1.08	16.99	10.49	108.8	0.964	8.46	2605.0
09/20/11	2	2.03	16.94	10.37	107.5	0.958	8.47	702.1
09/20/11	3	3.08	16.93	10.18	105.4	0.957	8.45	243.4
09/20/11	4	3.86	16.94	9.90	102.6	0.955	8.47	38.2

Table 3. Fourth Lake multiparameter data, 2011.

Fourth Lake Deep Hole Multiparameter

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
5/17/2011	0.25	0.50	12.94	11.51	109.5	1.054	8.22	3841.1
5/17/2011	1	0.99	12.95	11.48	109.2	1.055	8.19	3323.5
5/17/2011	2							

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
6/21/2011	0.25	0.52	23.43	4.86	57.3	0.999	7.50	2059.6
6/21/2011	1	1.03	23.18	3.59	42.1	0.999	7.35	2077.6
6/21/2011	2	1.86	22.95	3.27	38.2	1.006	7.31	81.4

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
	0.25	0.48	29.00	7.94	103.6	1.285	6.91	2037
7/19/2011	1	1.06	28.43	3.15	40.7	1.219	7.12	3219.7
7/19/2011	2	1.91	27.51	2.19	27.8	1.224	7.06	480.9

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
	0.25	0.50	22.30	8.99	103.6	0.933	7.84	2736.5
8/16/2011	1	0.99	22.16	5.34	61.4	0.913	7.54	2222
8/16/2011	2	1.92	21.90	4.33	49.5	0.913	7.41	63.8
8/16/2011	3	3.01	21.89	3.62	41.4	0.961	7.23	39.6

Date MMDDYY	Text Depth Feet	Dep25 feet	Temp øC	DO mg/l	DO% Sat	SpCond mS/cm	pH Units	PAR æE/s/mý
	0.25	0.54	15.10	5.77	57.5	1.039	8.02	597.2
9/20/2011	1	0.94	15.11	3.56	35.5	1.036	7.77	1734.7
9/20/2011	2	2.06	15.20	3.00	29.9	0.922	7.64	78.2

Figure 2. Secchi depth (water clarity) in Fourth Lake during 2011.

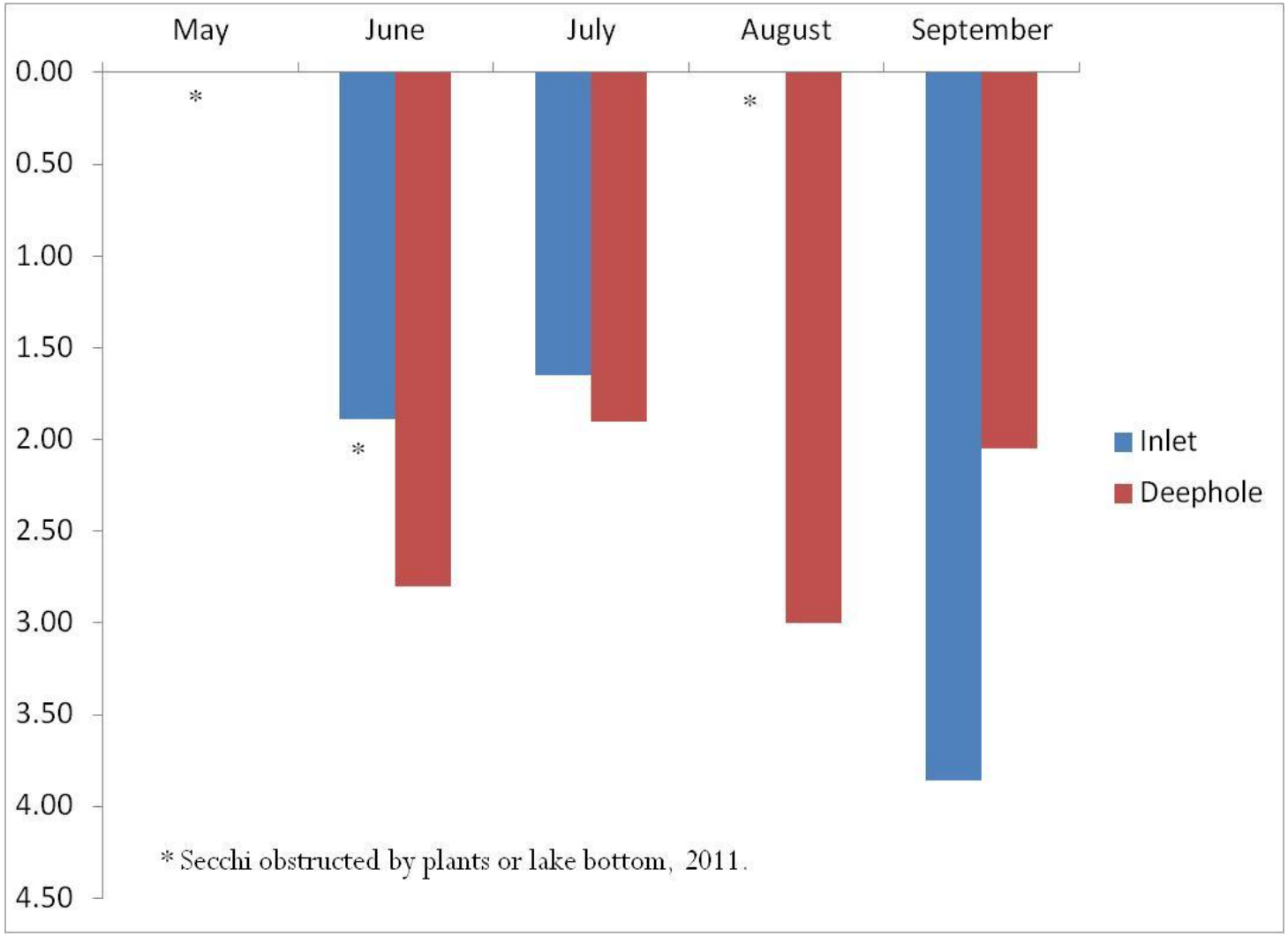

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2011.

RANK	LAKE NAME	SECCHI AVE	TSIsd
1	West Loon	16.97	36.00
2	Windward Lake	14.28	38.81
3	Lake Carina	13.21	39.93
4	Druce Lake	12.25	41.00
5	Pulaski Pond	11.69	41.69
6	Independence Grove	11.50	41.93
7	Cedar Lake	11.14	42.00
8	Sterling Lake	11.35	42.12
9	Lake Zurich	10.40	43.38
10	Bangs Lake	10.14	44.00
11	Schreiber Lake	9.59	44.54
12	Little Silver Lake	9.42	44.80
13	Old School Lake	9.40	44.83
14	Lake Kathryn	9.39	44.85
15	Lake of the Hollow	9.28	45.02
16	Dugdale Lake	9.22	45.11
17	Dog Training Pond	9.04	45.39
18	Banana Pond	8.85	45.70
19	Deep Lake	8.83	45.73
20	Stone Quarry Lake	8.81	45.77
21	Cross Lake	8.18	46.84
22	Ames Pit	8.14	46.91
23	Davis Lake	8.14	46.91
24	Briarcrest Pond	8.00	47.00
25	Lake Miltmore	7.35	48.00
26	Sand Lake	7.48	48.00
27	Sand Pond (IDNR)	7.42	48.24
28	Timber Lake (North)	7.37	48.34
29	Lake Leo	7.31	48.46
30	Nielsen Pond	7.23	48.61
31	Honey Lake	7.17	48.73
32	Lake Minear	7.13	48.81
33	Channel Lake	6.65	49.82
34	Highland Lake	6.58	49.97
35	Lake Catherine	6.58	49.97
36	Lake Helen	6.43	50.30
37	Sun Lake	6.33	50.53
38	Lake Lakeland Estates	6.31	50.58
39	Round Lake	6.25	50.71
40	Cranberry Lake	6.31	51.00
41	Lake Barrington	6.00	51.30
42	Lake Fairfield	5.89	51.57
43	Third Lake	5.73	52.00
44	Lake Fairview	5.59	52.32
45	Gages Lake	5.45	53.00
46	Old Oak Lake	5.08	53.70
47	Valley Lake	5.05	53.79

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2011.

RANK	LAKE NAME	SECCHI AVE	TSIsd
48	McGreal Lake	5.04	53.81
49	Hook Lake	5.03	53.84
50	Countryside Lake	5.01	54.00
51	Waterford Lake	4.70	54.82
52	North Tower Lake	4.61	55.10
53	Lake Linden	4.60	55.13
54	Peterson Pond	4.51	55.41
55	Owens Lake	4.38	55.84
56	Butler Lake	4.35	55.94
57	Mary Lee Lake	4.35	55.94
58	Tower Lake	4.31	56.07
59	Crooked Lake	4.28	56.17
60	Fourth Lake	2.44	56.37
61	Deer Lake	4.20	56.45
62	Seven Acre Lake	4.18	56.51
63	Lambs Farm Lake	4.17	56.54
64	Lake Naomi	4.05	56.97
65	East Loon Lake	4.08	57.00
66	Grays Lake	4.08	57.00
67	Wooster Lake	5.14	57.00
68	White Lake	3.96	57.29
69	Turner Lake	3.92	57.44
70	Leisure Lake	3.85	57.69
71	Salem Lake	3.77	58.00
72	Summerhill Estates Lake	3.65	58.46
73	Countryside Glen Lake	3.64	58.50
74	Little Bear Lake	3.63	58.54
75	Hastings Lake	3.52	58.99
76	Taylor Lake	3.52	58.99
77	Timber Lake (South)	3.51	59.03
78	Duck Lake	3.49	59.11
79	Bishop Lake	3.47	59.19
80	Fish Lake	3.47	59.19
81	Diamond Lake	3.44	59.32
82	Lake Holloway	3.40	59.49
83	Stockholm Lake	3.38	59.57
84	Forest Lake	3.27	60.00
85	Long Lake	3.23	60.00
86	Bresen Lake	3.28	60.00
87	Lucky Lake	3.22	60.27
88	Liberty Lake	3.16	60.54
89	International Mining and Chemical Lake	3.08	60.91
90	Lake Christa	3.01	61.24
91	Potomac Lake	3.00	61.29
92	Lucy Lake	2.99	61.34
93	Island Lake	2.90	61.78
94	Bluff Lake	2.85	62.03

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2011.

RANK	LAKE NAME	SECCHI AVE	TSIsd
95	St. Mary's Lake	2.79	62.34
96	Werhane Lake	2.71	62.75
97	Sylvan Lake	2.68	62.91
98	Petite Lake	2.66	63.02
99	East Meadow Lake	2.61	63.30
100	Broberg Marsh	2.50	63.92
101	Forest Lake	2.49	63.97
102	Antioch Lake	2.48	64.03
103	Spring Lake	2.46	64.15
104	Big Bear Lake	2.40	64.51
105	Lake Marie	2.25	65.44
106	Rivershire Pond 2	2.23	65.56
107	College Trail Lake	2.18	65.89
108	Loch Lomond	2.17	65.96
109	Echo Lake	2.11	66.36
110	Lake Charles	2.11	66.36
111	Eagle Lake (S1)	2.10	66.43
112	West Meadow Lake	2.07	66.64
113	Columbus Park Lake	2.03	66.92
114	Grand Ave Marsh	2.03	66.92
115	Harvey Lake	2.03	66.92
116	Grassy Lake	2.00	67.13
117	Bittersweet Golf Course #13	1.98	67.28
118	Fischer Lake	1.96	67.42
119	Pistakee Lake	1.88	68.02
120	Rasmussen Lake	1.80	68.65
121	Deer Lake Meadow Lake	1.73	69.22
122	Nippersink Lake (LCFPD)	1.73	69.22
123	Woodland Lake	1.72	69.31
124	Lake Louise	1.68	69.64
125	Slough Lake	1.63	70.08
126	Willow Lake	1.63	70.08
127	Lake Farmington	1.62	70.17
128	Half Day Pit	1.60	70.35
129	Dunn's Lake	1.54	70.90
130	Longview Meadow Lake	1.51	71.18
131	Lake Matthews	1.41	72.17
132	McDonald Lake 1	1.39	72.38
133	Fox Lake	1.37	72.58
134	Grass Lake	1.33	73.01
135	Nippersink Lake	1.28	73.56
136	Redhead Lake	1.27	73.68
137	Lake Eleanor	1.16	74.98
138	Buffalo Creek Reservoir	1.10	75.75
139	Rollins Savannah 1	1.05	76.00
140	Osprey Lake	1.03	76.69
141	Slocum Lake	1.03	76.72

Table 4. Average Secchi depths measured from lakes in Lake County, 2000-2011.

RANK	LAKE NAME	SECCHI AVE	TSIsd
142	Lake Napa Suwe	0.98	77.41
143	Rollins Savannah 2	0.95	78.00
144	Dog Bone Lake	0.94	78.01
145	Redwing Marsh	0.88	78.96
146	Flint Lake	0.83	79.81
147	Fairfield Marsh	0.81	80.16
148	Ozaukee Lake	0.81	80.16
149	Oak Hills Lake	0.79	80.52
150	Patski Pond	0.75	81.27
151	South Churchill Lake	0.73	81.66
152	Lake Forest Pond	0.71	82.06
153	ADID 127	0.66	83.11
154	Albert Lake	0.64	83.55
155	North Churchill Lake	0.61	84.24
156	Hidden Lake	0.56	85.53
157	McDonald Lake 2	0.50	87.11

Figure 3. Approximate watershed of Fourth Lake, 2011.

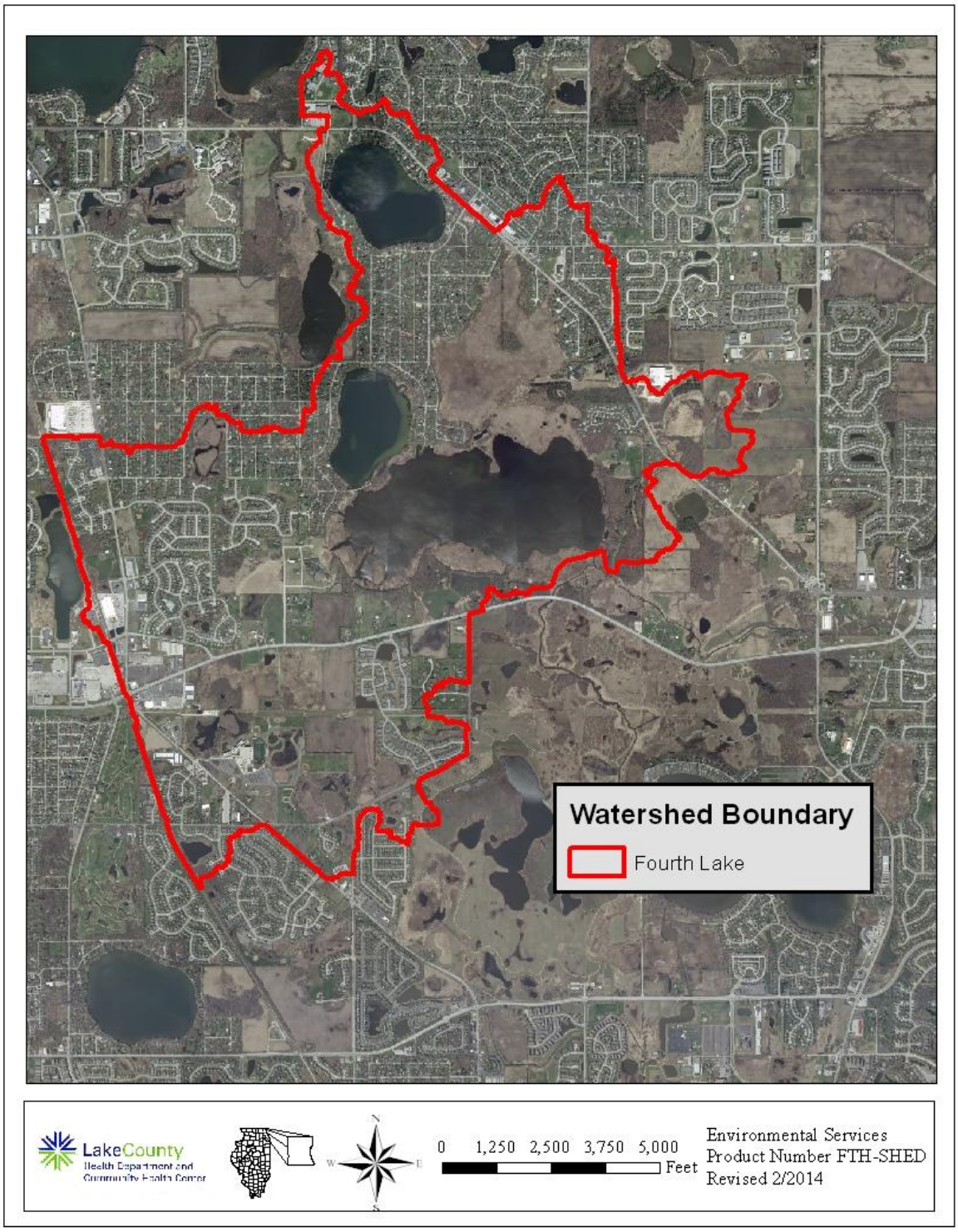

Figure 4. Estimated land use within watershed of Fourth Lake, 2011 (Based upon 2010 imagery).

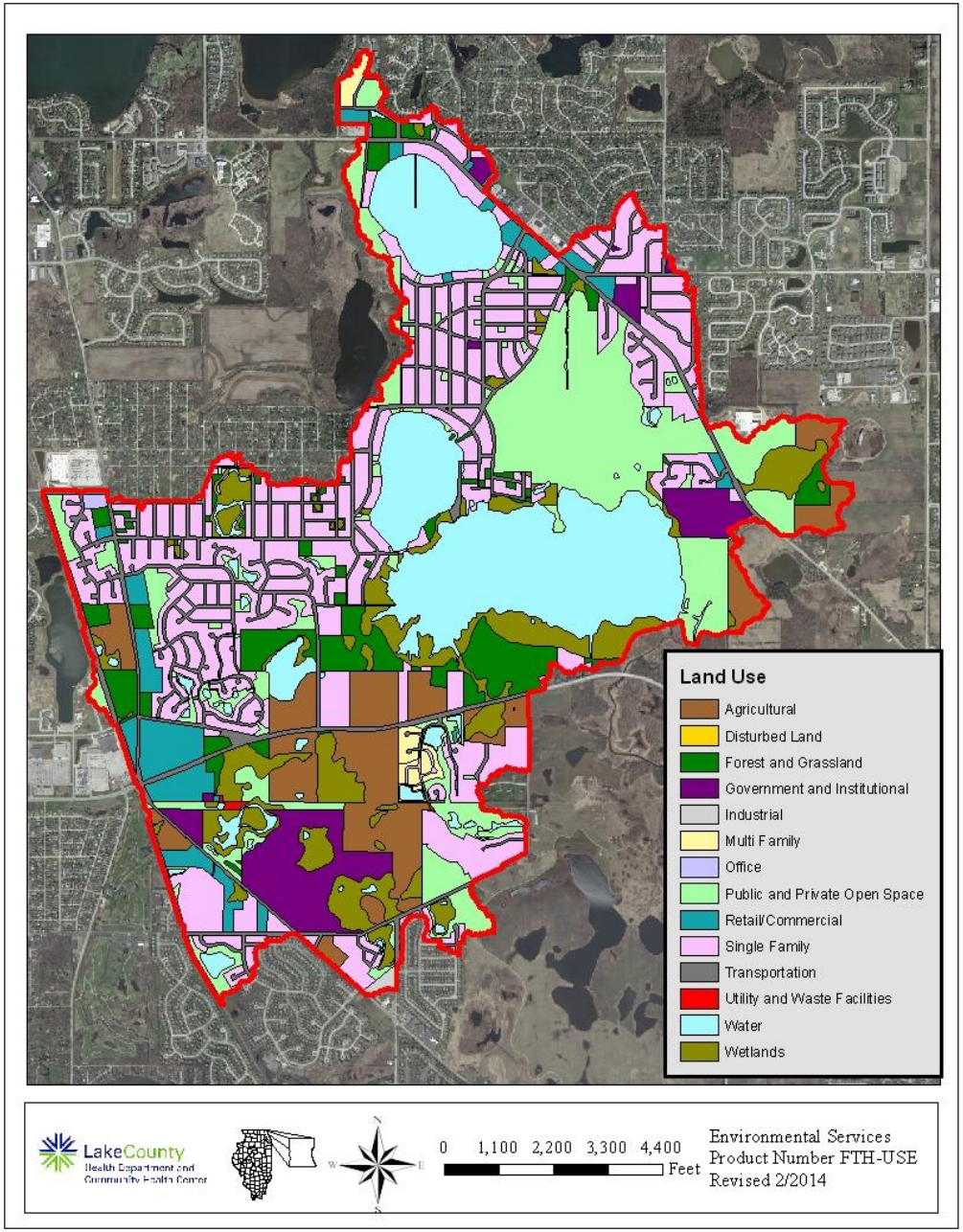

Table 5. Land use within Fourth Lake watershed, 2011.

Land Use	Acreage	% of Total
Agriculture	247.40	7.94%
Disturbed Land	0.00	0.00%
Forest and Grassland	180.88	5.81%
Government and Institutional	141.90	4.56%
Industrial	4.19	0.13%
Multi Family	23.06	0.74%
Office	3.41	0.11%
Public and Private Open Space	512.72	16.46%
Retail/Commercial	117.03	3.76%
Single Family	756.89	24.30%
Transportation	305.44	9.81%
Utility and Waste Facilities	2.39	0.08%
Water	550.76	17.68%
Wetlands	268.34	8.62%
TOTAL	**3114.40**	**100.00%**

Land Use	Acreage	Runoff Coeff.	Estimated Runoff, acft.	% total of Estimated Runoff
Agriculture	247.40	0.05	34.0	2.00%
Disturbed Land	0.00	0.05	0.0	0.00%
Forest and Grassland	180.88	0.05	24.9	1.46%
Govt. & Institution	141.90	0.50	195.1	11.49%
Industrial	4.19	0.80	9.2	0.54%
Multi Family	23.06	0.50	31.7	1.87%
Office	3.41	0.85	8.0	0.47%
Public & Private Open Space	512.72	0.05	70.5	4.15%
Retail/Commercial	117.03	0.75	241.4	14.22%
Single Family	756.89	0.30	624.4	36.77%
Transportation	305.44	0.50	420.0	24.73%
Utility and Waste Facilities	2.39	0.30	2.0	0.12%
Water	550.76	0.00	0.0	0.00%
Wetlands	268.34	0.05	36.9	2.17%
TOTAL	**3114.40**		**1698.0**	**100.00%**

Lake volume	**840.68**	**acre-feet**
Retention Time (years)= lake volume/runoff	**0.50**	**years**
	180.71	**days**

Table 6. Lake County average TSI phosphorus (TSIp) 2000 – 2011.

RANK	LAKE NAME	TP AVE	TSIp
1	Lake Carina	0.0100	37.35
2	Sterling Lake	0.0100	37.35
3	Independence Grove	0.0130	41.14
4	Lake Zurich	0.0135	41.68
5	Druce Lake	0.0140	42.00
6	West Loon	0.0152	43.00
7	Windward Lake	0.0160	44.13
8	Sand Pond (IDNR)	0.0165	44.57
9	Cedar Lake	0.0170	45.00
10	Pulaski Pond	0.0180	45.83
11	Gages Lake	0.0200	47.00
12	Banana Pond	0.0200	47.35
13	Lake Kathryn	0.0200	47.35
14	Lake Minear	0.0200	47.35
15	Highland Lake	0.0202	47.49
16	Lake Miltmore	0.0210	48.00
17	Timber Lake (North)	0.0210	48.05
18	Cross Lake	0.0220	48.72
19	Dog Training Pond	0.0220	48.72
20	Sun Lake	0.0220	48.72
21	Cranberry Lake	0.0230	49.00
22	Deep Lake	0.0230	49.36
23	Lake of the Hollow	0.0230	49.36
24	Round Lake	0.0230	49.36
25	Stone Quarry Lake	0.0230	49.36
26	Little Silver Lake	0.0250	50.57
27	Bangs Lake	0.0260	51.00
28	Lake Leo	0.0260	51.13
29	Dugdale Lake	0.0270	51.68
30	Peterson Pond	0.0270	51.68
31	Fourth Lake	0.0360	53.00
32	Lake Fairfield	0.0300	53.20
33	Third Lake	0.0300	53.33
34	Lake Catherine	0.0310	53.67
35	Lambs Farm Lake	0.0310	53.67
36	Old School Lake	0.0310	53.67
37	Grays Lake	0.0310	54.00
38	Hendrick Lake	0.0340	55.00
39	Honey Lake	0.0340	55.00
40	Sand Lake	0.0380	56.00
41	Diamond Lake	0.0370	56.22
42	Sullivan Lake	0.0370	56.22
43	Channel Lake	0.0380	56.60
44	Ames Pit	0.0390	56.98

Table 6. Lake County average TSI phosphorus (TSIp) 2000 – 2011.

45	East Loon	0.0400	57.00
46	Schreiber Lake	0.0400	57.34
47	Waterford Lake	0.0400	57.34
48	Hook Lake	0.0410	57.70
49	Duck Lake	0.0430	58.39
50	Nielsen Pond	0.0450	59.04
51	Seven Acre Lake	0.0460	59.36
52	Turner Lake	0.0460	59.36
53	Willow Lake	0.0460	59.36
54	East Meadow Lake	0.0480	59.97
55	Lucky Lake	0.0480	59.97
56	Old Oak Lake	0.0490	60.27
57	College Trail Lake	0.0500	60.56
58	Hastings Lake	0.0520	61.13
59	Lake Lakeland Estates	0.0520	61.13
60	Butler Lake	0.0530	61.40
61	West Meadow Lake	0.0530	61.40
62	Little Bear Lake	0.0550	61.94
63	Lucy Lake	0.0550	61.94
64	Lake Linden	0.0570	62.45
65	Lake Napa Suwe	0.0570	62.45
66	Lake Charles	0.0580	62.70
67	Lake Christa	0.0580	62.70
68	Owens Lake	0.0580	62.70
69	Briarcrest Pond	0.0580	63.00
70	Lake Naomi	0.0620	63.66
71	Lake Tranquility (S1)	0.0620	63.66
72	Liberty Lake	0.0630	63.89
73	Werhane Lake	0.0630	63.89
74	Countryside Glen Lake	0.0640	64.12
75	Davis Lake	0.0650	64.34
76	Lake Fairview	0.0650	64.34
77	Leisure Lake	0.0650	64.34
78	Tower Lake	0.0660	64.56
79	St. Mary's Lake	0.0670	64.78
80	Mary Lee Lake	0.0680	65.00
81	Wooster Lake	0.0690	65.00
82	Crooked Lake	0.0700	65.41
83	Lake Helen	0.0720	65.82
84	Grandwood Park Lake	0.0720	66.00
85	ADID 203	0.0730	66.02
86	Bluff Lake	0.0730	66.02
87	Spring Lake	0.0730	66.02
88	Harvey Lake	0.0770	66.79
89	Broberg Marsh	0.0780	66.97
90	Countryside Lake	0.0780	67.00
91	Sylvan Lake	0.0790	67.16
92	Big Bear Lake	0.0810	67.52
93	Redwing Slough	0.0822	67.73

Table 6. Lake County average TSI phosphorus (TSIp) 2000 – 2011.

94	Petite Lake	0.0830	67.87
95	Forest Lake	0.0820	68.00
96	Lake Marie	0.0850	68.21
97	Potomac Lake	0.0850	68.21
98	Timber Lake (South)	0.0850	68.21
99	White Lake	0.0862	68.42
100	Grand Ave Marsh	0.0870	68.55
101	North Churchill Lake	0.0870	68.55
102	McDonald Lake 1	0.0880	68.71
103	North Tower Lake	0.0880	68.71
104	Long Lake	0.0850	69.00
105	Rivershire Pond 2	0.0900	69.04
106	South Churchill Lake	0.0900	69.04
107	McGreal Lake	0.0910	69.20
108	Deer Lake	0.0940	69.66
109	Dunn's Lake	0.0950	69.82
110	Eagle Lake (S1)	0.0950	69.82
111	International Mine and Chemical Lake	0.0950	69.82
112	Valley Lake	0.0950	69.82
113	Fish Lake	0.0960	69.97
114	Lochanora Lake	0.0960	69.97
115	Island Lake	0.0990	70.41
116	Woodland Lake	0.0990	70.41
117	Nippersink Lake	0.1000	70.56
118	Longview Meadow Lake	0.1020	70.84
119	Lake Barrington	0.1050	71.26
120	Lake Forest Pond	0.1070	71.53
121	Bittersweet Golf Course #13	0.1100	71.93
122	Fox Lake	0.1100	71.93
123	Middlefork Savannah Outlet 1	0.1120	72.00
124	Osprey Lake	0.1110	72.06
125	Bresen Lake	0.1130	72.32
126	Round Lake Marsh North	0.1130	72.32
127	Deer Lake Meadow Lake	0.1160	72.70
128	Taylor Lake	0.1180	72.94
129	Columbus Park Lake	0.1230	73.54
130	Lake Nippersink	0.1240	73.66
131	Echo Lake	0.1250	73.77
132	Grass Lake	0.1290	74.23
133	Lake Holloway	0.1320	74.56
134	Redhead Lake	0.1410	75.51
135	Antioch Lake	0.1450	75.91
136	Slocum Lake	0.1500	76.40
137	Lakewood Marsh	0.1510	76.50
138	Pond-A-Rudy	0.1510	76.50
139	Lake Matthews	0.1520	76.59
140	Buffalo Creek Reservoir	0.1550	76.88
141	Middlefork Savannah Outlet 2	0.1590	77.00
142	Pistakee Lake	0.1590	77.24

Table 6. Lake County average TSI phosphorus (TSIp) 2000 – 2011.

143	Grassy Lake	0.1610	77.42
144	Salem Lake	0.1650	77.78
145	Half Day Pit	0.1690	78.12
146	Lake Eleanor	0.1810	79.11
147	Lake Farmington	0.1850	79.43
148	Lake Louise	0.1850	79.43
149	ADID 127	0.1890	79.74
150	Patski Pond	0.1970	80.33
151	Dog Bone Lake	0.1990	80.48
152	Summerhill Estates Lake	0.1990	80.48
153	Redwing Marsh	0.2070	81.05
154	Stockholm Lake	0.2082	81.13
155	Bishop Lake	0.2160	81.66
156	Ozaukee Lake	0.2200	81.93
157	Hidden Lake	0.2240	82.19
158	McDonald Lake 2	0.2250	82.28
159	Fischer Lake	0.2280	82.44
160	Oak Hills Lake	0.2790	85.35
161	Loch Lomond	0.2950	86.16
162	Heron Pond	0.2990	86.35
163	Rollins Savannah 1	0.3070	87.00
164	Fairfield Marsh	0.3260	87.60
165	ADID 182	0.3280	87.69
166	Slough Lake	0.3860	90.03
167	Flint Lake Outlet	0.5000	93.76
168	Rasmussen Lake	0.5030	93.85
169	Rollins Savannah 2	0.5870	96.00
170	Albert Lake, Site II, outflow	1.1894	106.26
171	Almond Marsh	1.9510	113.00

Figure 5. Conductivity concentrations measured in Fourth Lake overlaid onto rain gauge data (LCSMC Lindenhurst rain gauge), 2011.

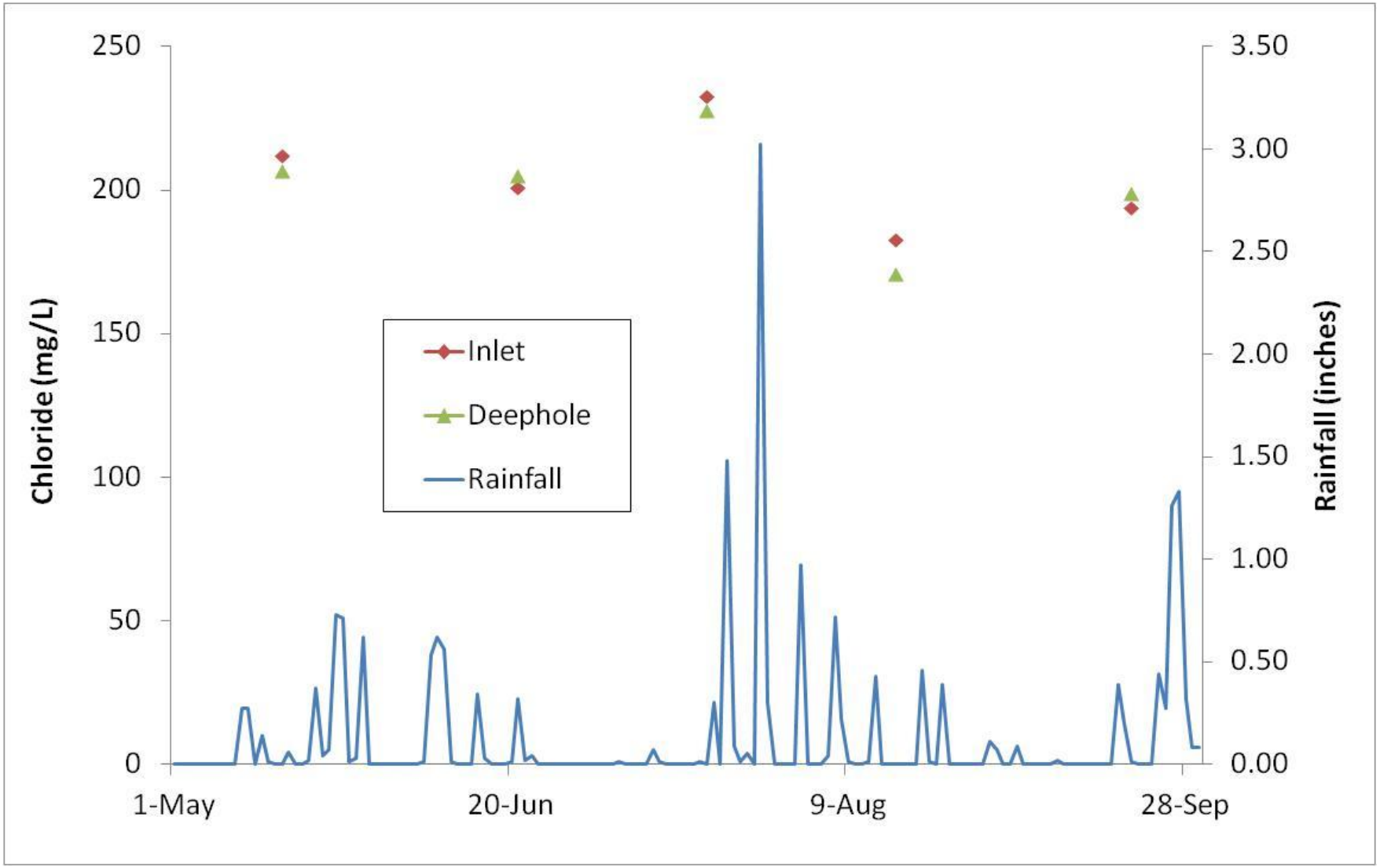

Figure 6. Location and density of aquatic vegetation in Fourth Lake, 2011.

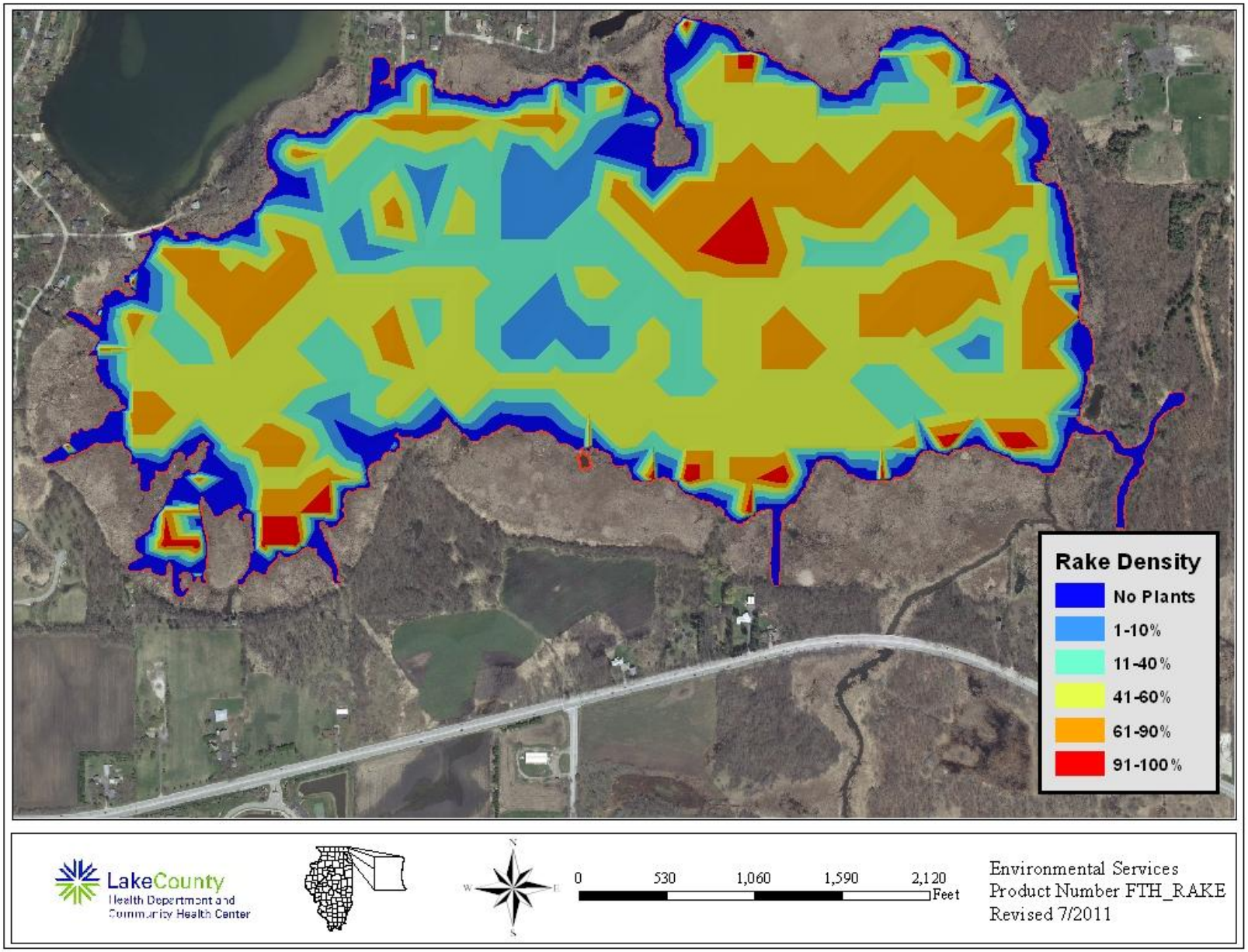

Figure 7. Location and estimated densities of EWM, Fourth Lake, 2011.

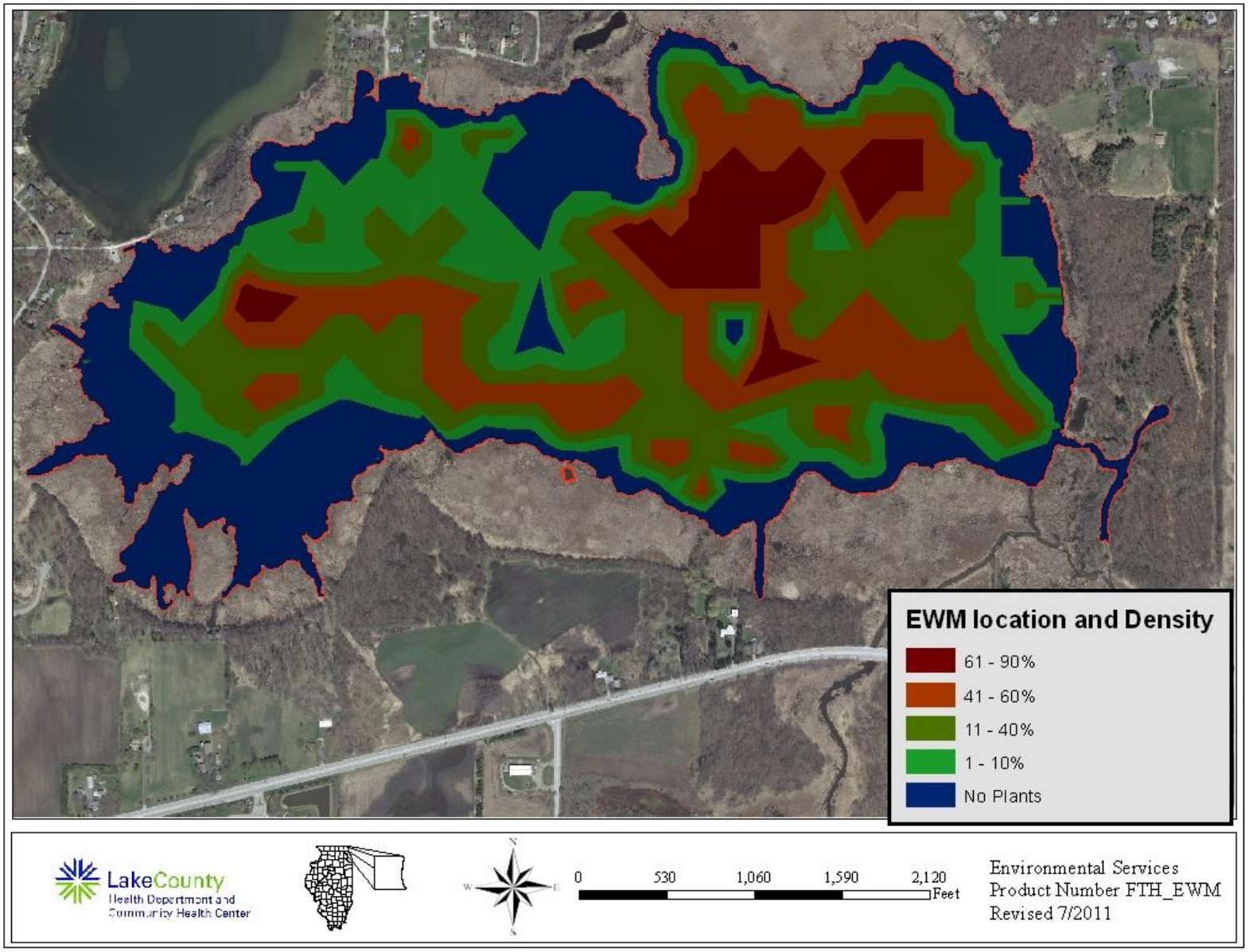

Table 4a. Aquatic vegetation species found at the 229 sampling sites on Fourth Lake, July 2011. Maximum depth that plants were found was 4.5 feet.

Plant Density	Bladderwort	Chara	Coontail	Curly leaf Pondweed	Common Duckweed	Eurasian Water Milfoil	Flatstem Pondweed	Giant Duckweed	Illinois Pondweed	Sago Pondweed
Absent	114	196	207	226	199	77	226	213	157	185
Present	23	15	5	1	14	42	1	7	21	20
Common	39	13	8	1	10	55	1	7	28	21
Abundant	42	4	2	0	5	43	0	1	20	2
Dominant	10	0	6	0	0	11	0	0	2	0
% Plant Occurrence	50.0%	14.0%	9.2%	0.9%	12.7%	66.2%	0.9%	6.6%	31.1%	18.9%

Plant Density	Small Pondweed	Southern Naiad	Spatterdock	Spiny Naiad	Star Duckweed	Valisneria	Watermeal	Water Stargrass	White Water Lily
Absent	227	226	226	171	223	225	226	226	116
Present	0	1	0	21	5	1	1	2	27
Common	1	1	0	27	0	2	1	0	35
Abundant	0	0	2	8	0	0	0	0	31
Dominant	0	0	0	1	0	0	0	0	19
% Plant Occurrence	0.4%	0.9%	0.9%	25.0%	2.2%	1.3%	0.9%	0.9%	49.1%

Table 4b. Distribution of rake density across all sampling sites

Rake Density (Coverage)	# of Sites	%
No plants	7	3.1
>0 to 10%	13	5.7
>10 to 40%	39	17.1
>40 to 60%	91	39.9
>60 to 90%	60	26.3
>90%	18	7.9
Total Sites with Plants	221	96.9
Total # of Sites	228	100.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

RANK	LAKE NAME	FQI (w/A)	FQI (native)
1	Cedar Lake	38.4	37.0
2	East Loon Lake	37	35.6
3	West Loon Lake	33.7	32.3
4	Little Silver	31.6	29.6
5	Deep Lake	31.2	29.7
6	Round Lake Marsh North	29.9	29.1
7	Cranberry Lake	28.9	28.0
8	Sullivan Lake	28.5	26.9
9	Independence Grove	27.5	24.6
10	Fourth Lake	27.1	24.7
11	Lake Zurich	27.1	24.3
12	Bangs Lake	26.9	25.2
13	Sterling Lake	26.9	24.5
14	Sun Lake	26.1	24.3
15	Round Lake	25.9	23.5
16	Honey Lake	25.1	23.3
17	Lake of the Hollow	24.8	23.0
18	Schreiber Lake	24.8	23.9
19	Lakewood Marsh	24.7	23.8
20	Redwing Slough	24.0	25.8
21	Deer Lake	23.5	24.4
22	Butler Lake	23.1	21.4
23	Duck Lake	22.9	21.1
24	Countryside Glen Lake	22.8	21.9
25	Cross Lake	22.4	24.2
26	McGreal Lake	22.1	20.2
27	Druce Lake	21.8	19.1
28	Third Lake	21.7	13.2
29	Broberg Marsh	21.4	20.5
30	Davis Lake	21.4	21.4
31	Fish Lake	21.2	19.3
32	Redhead Lake	21.2	19.3
33	Turner Lake	21.2	18.6
34	Wooster Lake	21.1	19.4
35	Timber Lake (North)	20.9	23.4
36	Lake Kathryn	20.7	19.6
37	ADID 203	20.5	20.5
38	Salem Lake	20.2	18.5
39	Old Oak Lake	19.1	18.0
40	Grandwood Park Lake	19.0	17.2
41	Highland Lake	18.9	16.7
42	Lake Miltmore	18.7	16.8
43	Lake Helen	18.0	18.0
44	Bresen Lake	17.8	16.6
45	Potomac Lake	17.8	17.8
46	Hendrick Lake	17.7	17.7
47	Lake Barrington	17.7	16.7
48	Long Lake	17.7	15.8
49	Rollins Savannah 2	17.7	17.7
50	Windward Lake	17.6	16.3
51	Diamond Lake	17.4	16.3
52	Almond Marsh	17.3	16.3
53	Osprey Lake	17.3	15.5
54	Owens Lake	17.3	16.3

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
55	Forest Lake	17.0	15.9
56	Lake Tranquility (S1)	17.0	15.0
57	McDonald Lake 1	16.7	17.7
58	Island Lake	16.6	14.7
59	Countryside Lake	16.3	15.2
60	Grand Avenue Marsh	16.3	14.3
61	Lake Fairview	16.3	15.2
62	Lake Nippersink	16.3	14.3
63	Taylor Lake	16.3	14.3
64	Grays Lake	16.1	16.1
65	White Lake	16.0	17.0
66	Dog Training Pond	15.9	14.7
67	Dog Bone Lake	15.7	15.7
68	Ames Pit	15.5	13.4
69	Seven Acre Lake	15.5	17.0
70	Dugdale Lake	15.1	14.0
71	Eagle Lake (S1)	15.1	14.0
72	Heron Pond	15.1	15.1
73	Mary Lee Lake	15.1	13.1
74	Old School Lake	15.1	13.1
75	Bishop Lake	15	13.4
76	Hastings Lake	15.0	17.0
77	North Churchill Lake	15.0	15.0
78	Timber Lake (South)	14.7	12.7
79	Buffalo Creek Reservoir	14.3	13.1
80	Lake Carina	14.3	12.1
81	Lake Leo	14.3	12.1
82	Lambs Farm Lake	14.3	12.1
83	Crooked Lake	14.0	16.0
84	Dunn's Lake	13.9	12.7
85	Lake Minear	13.9	11.0
86	Lake Napa Suwe	13.9	11.7
87	Longview Meadow Lake	13.9	13.9
88	Summerhill Estates Lake	13.9	12.7
89	Stockholm Lake	13.5	12.1
90	Antioch Lake	13.4	11.3
91	Hook Lake	13.4	11.3
92	Lake Charles	13.4	11.3
93	Rivershire Pond 2	13.3	11.5
94	Flint Lake	13.0	11.8
95	Harvey Lake	13.0	11.8
96	Briarcrest Pond	12.5	11.2
97	Gages Lake	12.5	10.2
98	Lake Naomi	12.5	11.2
99	McDonald Lake 2	12.5	12.5
100	Pulaski Pond	12.5	11.2
101	Rollins Savannah 1	12.5	12.5
102	Stone Quarry Lake	12.5	12.5
103	Loch Lomond	12.1	9.4
104	Pond-A-Rudy	12.1	12.1
105	Grassy Lake	12.0	12.0
106	Lake Matthews	12.0	12.0
107	Nielsen Pond	12.0	10.7
108	Werhane Lake	12.0	9.8
109	Lake Lakeland Estates	11.5	10.0
110	Big Bear Lake	11.0	9.5
111	Fischer Lake	11.0	9.0

Lake County average Floristic Quality Index (FQI) ranking 2000-2011.

Rank	LAKE NAME	FQI (w/A)	FQI (native)
112	Little Bear Lake	11.0	9.5
113	Redwing Marsh	11	11.0
114	Tower Lake	11.0	11.0
115	West Meadow Lake	11.0	11.0
116	Lake Holloway	10.6	10.6
117	Lake Fairfield	10.4	9.0
118	Lake Louise	10.4	9.0
119	Sand Lake	10.4	8.0
120	College Trail Lake	10.0	10.0
121	Valley Lake	9.9	9.9
122	Woodland Lake	9.9	8.1
123	Lake Christa	9.8	8.5
124	Lake Farmington	9.8	8.5
125	Lucy Lake	9.8	8.5
126	Banana Pond	9.2	7.5
127	Columbus Park Lake	9.2	9.2
128	Sylvan Lake	9.2	9.2
129	Waterford Lake	9.2	9.2
130	Leisure Lake	9.0	6.4
131	Albert Lake	8.7	7.5
132	Fairfield Marsh	8.7	7.5
133	Lake Eleanor	8.7	7.5
134	Ozaukee Lake	8.7	6.7
135	East Meadow Lake	8.5	8.5
136	Lake Forest Pond	8.5	6.9
137	Peterson Pond	8.5	6.0
138	South Churchill Lake	8.5	8.5
139	Bittersweet Golf Course #13	8.1	8.1
140	Lake Linden	8.0	8.0
141	IMC Lake	7.1	5.0
142	Patski Pond	7.1	7.1
143	Rasmussen Lake	7.1	7.1
144	Slocum Lake	7.1	5.8
145	Lucky Lake	7.0	7.0
146	Deer Lake Meadow Lake	6.4	5.2
147	ADID 127	5.0	5.0
148	Half Day Pit	5.0	2.9
149	Liberty Lake	5.0	5.0
150	Lochanora Lake	5.0	2.5
151	Oak Hills Lake	5.0	5.0
152	Sand Pond (IDNR)	5.0	3.5
153	Slough Lake	5.0	5.0
154	Echo Lake	0.0	0.0
155	Hidden Lake	0.0	0.0
156	North Tower Lake	0.0	0.0
157	St. Mary's Lake	0.0	0.0
158	Willow Lake	0.0	0.0
	Mean	**15.2**	**14.1**
	Median	**14.3**	**13.1**